TOPEX Sigma0 Calibration Table History for All Side A Data

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ABSTRACT

Throughout the TOPEX/Poseidon mission, we have been conducting performance analysis and engineering assessment for that mission's NASA radar altimeter, hereafter referred to simply as the TOPEX altimeter. Among the TOPEX altimeter's output products are estimates of the ocean surface's normalized backscattering cross section (designated sigma0 for typographical convenience). After almost four years of TOPEX data, calibration changes in the TOPEX Ku- and C-band sigma0 estimation were described in the paper "TOPEX Sigma0 Calibration Table and its Updates", by G. S. Hayne and D. W. Hancock, March 14, 1997, hereafter referred to as HH97. The results in HH97 were for the TOPEX Side A which was operated from launch through end of January 1999. In February 1999 the TOPEX altimeter was switched to its Side B at the beginning of cycle 236, and continues to operate in Side B through the present time. This paper is intended as an update to and a replacement for HH97, and is intended to act as a single-document description of calibration changes for all of the Side A data from cycles 001 through 235 (which ended on 09 February 1999). In addition to listing the calibration table values applied to each TOPEX data cycle in the Side A operation, we provide results of a sigma0 trend fit to the entire Side A over-ocean data set; this is our current best estimate of calibration values which should have been applied to Side A data.

INTRODUCTION

From launch and continuing throughout the life of the TOPEX/Poseidon mission, our group at Wallops Flight Facility (WFF) has been conducting performance analysis and engineering assessment for the TOPEX/Poseidon mission's NASA radar altimeter, hereafter referred to simply as the TOPEX altimeter. Among the TOPEX altimeter's output products are estimates of sigma0, the ocean surface's normalized backscattering cross section. We had earlier described calibration changes for the TOPEX altimeter Ku- and C-band sigma0 estimates in Callahan *et al*. [1994]. Then after two additional years of TOPEX data, we reexamined the sigma0 calibration issue and issued an update and replacement for the earlier paper as Hayne and Hancock [1997] (hereafter referred to as HH97).

The TOPEX altimeter consists of two redundant systems, referred to as Side A and Side B. Both Side A and Side B were tested in the pre-launch ground testing. The results discussed in the preceding paragraph were for the TOPEX Side A, the only system that was operated from launch

through end of January 1999. In February 1999 the TOPEX altimeter was switched to its Side B at the beginning of cycle 236, and continues to operate in Side B through the present time.

This paper is intended as an update to and a replacement for HH97, and includes all of the Side A data from cycles 001 through 235 (which ended on 09 February 1999). There is one important difference from HH97: the GDRs for cycles 133-149 were reprocessed and rereleased and in HH97 we tried to make clear what calibration table values were used in the originally released GDRs and what values were used in the rereleased GDRs. We will not do that here, but will describe only the calibration table values used in the rereleased GDRs; in the unlikely event that you are using data from the first-released GDRs for cycles 133-149, you will have to go back to HH97. For the paper you are now reading, we will assume that you have one of only two types of TOPEX data: 1) the TOPEX Geophysical Data Record product (GDR), with the recalculated, reissued GDRs for cycles 133-149; or 2) the merged GDR (TOPEX/Poseidon) Generation B, hereafter referred to as the MGDR-B.

BACKGROUND

For an over-ocean radar altimeter whose transmitted power is constant, the received backscattered power is proportional to sigma0. As the altimeter ages, its transmitted power tends to drift slowly (usually downward) by a few dB, its receiver characteristics also can drift, and it is necessary to account for these drifts in power estimation when calculating sigma0 estimates from the altimeter data.

In TOPEX ground data processing for the intermediate geophysical data record (IGDR) there is a sigma0 calibration table which, for each TOPEX data cycle, contains one additive correction for the Ku-band sigma0 and one additive correction for the C-band sigma0. We will refer to the sigma0 calibration table as the Cal Table in the following. The power estimation drift is slow enough that for any data cycle the Cal Table values do not change for any passes within the cycle but need to be changed only every several cycles.

At launch the Cal Table values were zero for both Ku- and C-band. We had expected to provide Cal Table updates based on calibration mode data. When by data cycle 048 it became clear that the Cal Table values needed to be updated, the calibration mode results disagreed somewhat with cycle averages of global over-ocean sigma0, and we decided to make the Cal Table update based on the trend in the global over-ocean sigma0_uncorr. By sigma0_uncorr, we mean the GDR sigma0 value with the Cal Table correction removed. In effect, the sigma0_uncorr is the GDR sigma0 which would have been produced if all the Cal Table values had been zero when producing the GDR.

For the first three years of TOPEX data both the Ku- and the C-band global sigma0_uncorr appeared to decrease linearly with time (or with data cycle number), although with different slopes. However, after four years of TOPEX data, we noted in HH97 that some polynomial degree higher than linear was necessary to describe the sigma0_uncorr time trends. After examining the approximately six years of Side A data, we feel that a quadratic polynomial form seems adequate for these trends.

This paper will describe the Cal Table values actually used in producing the TOPEX GDR (rereleased for cycles 133 - 149) and the TOPEX altimeter part of the MGDR-B, as well as our current best estimates of what those values should have been. After briefly describing the TOPEX calibration mode, we will compare calibration mode data with the sigma0_uncorr data. We will describe how the Cal Table values are documented and how to find what Cal Table values were used for each TOPEX cycle's GDR production. We will then describe the time trend fitting for cycles 017 through 235 of the sigma0_uncorr data, and provide tables which allow the TOPEX data user to make small improvements to the sigma0 estimates from the GDR or the MGDR-B.

THE TOPEX ALTIMETER'S INTERNAL CALIBRATION MODE

The TOPEX altimeter's internal calibration mode has two submodes referred to as Cal-1 and Cal-2. In Cal-1 a portion of the transmitter output is fed back to the receiver through a digitally controlled calibration attenuator and a delay line. The altimeter acquires and tracks this calibration signal for 10 seconds for each of 17 different preset attenuator values (each step change is 2 dB). The altimeter's automatic gain control (AGC) loop is active during each Cal-1 step, so Cal-1 should provide information on changes in the altimeter's range and power estimation. The altimeter's Cal-1 and its normal fine-track mode have the same hardware except that Cal-1 has a delay line, a different attenuator, and switches to select these components; in principle the Cal-1 AGC measurements should be directly relatable to changes in the altimeter's power estimation. In Cal-2 the altimeter processes receiver thermal noise, with no transmitted signal present, primarily to characterize the waveform sampler response but Cal-2 should also provide additional information on the received power estimation.

When commanded to the calibration mode, the TOPEX altimeter first enters Cal-1 and then Cal-2. Cal-1 has 17 different steps, each lasting about 10 seconds, and Cal-2 lasts about a minute, so the entire calibration mode lasts about 4 minutes. There are normally two calibration modes commanded in each day of TOPEX altimeter operation, and these calibrations are scheduled over land to avoid loss of ocean data.

CALIBRATION MODE RESULTS COMPARED WITH UNCORRECTED GLOBAL SIGMA0 AVERAGES

Routine WFF processing and databases for TOPEX

As part of our continuing TOPEX support, we do daily quick-look processing of all TOPEX altimeter data for performance monitoring, providing performance summaries for the engineering and science data. The daily processing results are used to update a launch-to-date engineering database. Also the daily calibration mode data (two calibration modes per day, normally) are processed and the results used to update a WFF launch-to-date calibration database. We also process the intermediate geophysical data record (IGDR) data as they become available for network access, normally several days after the altimeter acquires the data. The IGDR data are processed for

altimeter performance, and 1-minute summary records are produced and are added to a WFF launch-to-date IGDR database. When the GDR data become available, they replace the IGDR data already in our database. There is no difference, however, between sigma0 data on the IGDR and the GDR, because no further sigma0 corrections are made in going from the IGDR to the GDR.

We have been very concerned about contamination of the data by what we have come to call "sigma0 blooms", regions of over-ocean altimeter data characterized by unusually high apparent sigma0 values accompanied by unusual altimeter waveform shapes. Generally the Ku-and the C-band sigma0 show the same behavior in a bloom region. Such blooms in the TOPEX data can persist for several tens of seconds, and the waveforms in a bloom region generally have too rapid a plateau decay. Many of these waveforms are too sharply peaked ("specular") indicating a breakdown in the general incoherent scattering theory used to characterize the rough surface scattering. The sigma0 blooms exist in perhaps 5% of all TOPEX over-ocean data (there is additional sigma0 bloom information on our web page at http://topex.wff.nasa.gov/blooms/blooms.html). For input to our GDR database 1-minute averages, we require all the available altimeter flags to show normal tracking and the land/water flag to show deep water. When the data are extracted from this database for the sigma0 calibration, all records are rejected that have Ku-band sigma0 estimates of 16 dB or greater or that have waveform-estimated attitude angles of 0.12 degrees or greater.

Discussion of Documentation of Cal Table Changes

Because our analysis is based on sigma0_uncorr, we need to know what Cal Table values have been already applied to the GDR (or IGDR) data in order to "undo" these corrections. There have been eighteen Cal Table adjustments over the time of TOPEX Side A operation, as discussed briefly in a later section of this paper "History of Cal Table Values Used in GDR Production". There exists no single summary of exactly when each of the Cal Table changes was implemented in the TOPEX ground processing, so we will try to provide that summary here.

Each time that the Cal Table contents are changed in the TOPEX ground data processing at JPL, there are at least these three items created within the Mission Operations System (MOS):

* The MOS Change Request Form (the MCR) bears an origination date, describes the change to be made and the desired operational date for the change, and also has the date when the MCR was approved (by a change control board at JPL).
* The Parameter File is the text file to be actually used in the data processing and containing the Cal Table values for each cycle.
* The File Release Form contains the Parameter File creation date, the release approval date, and the date at which file execution is to begin.

The MCR Form is usually accompanied by other supporting information from WFF describing why the change is being requested, but what is being discussed now is not why but when the change was actually implemented. In Table 1 we have summarized information from copies of the sigma0-related MCRs and File Release Forms relevant to the rereleased GDRs and the MGDR-Bs. Columns 1 to 4 of Table 1 are transcribed from the MCR Forms, columns 5 to 7 from the File Release Forms, and column 8 contains a brief indication of what change the MCR made and why.

Column 9 of Table 1 indicates which of the TOPEX GDRs were governed by each MCR. MCR #618, October 1996, contains the Cal Table values for the MGDR-Bs up through cycle149, and the MGDR-B and GDR. For TOPEX cycles numbered 133 or greater, the MGDR-Bs had the same Cal Table values as the rereleased GDRs. Because this report is restricted to only the rereleased GDRS (for cycles 133 - 149) we have not included in Table 1 the MCRs #598, #608, and #614 because those MCRs are relevant only to the originally released GDRs (see Table 1 of HH97 if you need that information).

Comparison of results from WFF calibration database and IGDR database

Figures 1a and 1b show our Ku- and C-band calibration database and GDR database comparisons for TOPEX cycle-averages. The several curves in Figure 1a and 1b have been shifted in order to be plotted on common y-axes, and the figure legend indicates the shift value. In all discussions of sigma0_uncorr trends, the TOPEX cycles 1 - 10 should be ignored, because of early operational procedures. In the earlier work described in HH97 there had been an adjustment to the sigma0_uncorr as a function of SWH; we do not make any SWH compensation of sigma0_uncorr in the work now being described. Only one of the Cal-1 steps, Step 5, is shown because Step 5 operates at an altimeter AGC level close to that of normal over-ocean tracking; however, the other Cal-1 steps show the same general trends as Step 5.

In the Ku-band results in Figure 1a, the sigma0_uncorr trend is shown by the solid dots. The Ku-band Cal-2 results, shown by the dotted line in Figure 1a, have the same general downward trend until cycle 50 or so, after which the Cal-2 data seem to level off although there is still a slow gradual downward trend with time. The Ku-band Cal-1 data, shown by the solid line in Figure 1a, have the same general time trend as the sigma0_uncorr, but show slope differences around cycle 50 and then around cycle 118.

The C-band results in Figure 1b have a different Cal-2 behavior, nearly constant with time for cycles 001 to 162. We do not know why the Ku- and C-band Cal-2 results show such different behavior. The C-band Cal-1 data in Figure 1b show overall agreement with the C-band sigma0_uncorr, but there is still a puzzling C-band Cal-1 change around cycle 118.

Transmitted power monitor words for both the Ku- and the C-band in the TOPEX engineering data are also plotted as the uppermost data shown in Figures 1a and 1b. The transmitted power monitor variations are not large enough to explain the observed trends in the Cal-1 data relative to the sigma0_uncorr.

For the sigma0 calibration work reported in Callahan *et al.* [1994], we had decided that there were small anomalies in the Calibration Mode behavior, and that it would be more realistic to use time trends of global average over-ocean sigma0_uncorr to produce the Cal Table values; this remains our approach in the work reported here. There is some risk in this, because we do not want to remove actual changes in the global over-ocean sigma0. There are certainly annual variations in the global sigma0, and perhaps semiannual and higher frequency variations as well, so we want to use only

longer term secular trends in the sigma0_uncorr to provide the Cal Table values. We will describe the Cal Table values actually used in the production of the TOPEX GDRs to date, and then will describe the sigma0_uncorr trend fitting.

History of Cal Table Values Used in GDR Production

Early in the TOPEX mission there were zero values in Ku- and C-band Cal Table. Eventually the sigma0_uncorr appeared to be drifting downward, and two step corrections were put into the Cal Table to compensate for the drift. Later in the mission the sigma0_uncorr drift over time appeared to be linear, and the linear Ku- and C-band trends were used to predict further entries for the Cal Table. The linear steps were first 0.05 dB, and then later the steps were provided at 0.03 dB increments. Later (April 1996) a change in the linear trend became necessary. Subsequently there have been additional changes in the linear trends used in predicting Cal Table values, and occasionally several-cycle "holds" or "freezes".

Here is a narrative summary of the Cal Table changes for computing the TOPEX GDR Ku- and C-band sigma0 estimates (see also column 8 of Table 1):

* Initially, the Cal Table values were zero.
* In January and March 1994, installed step corrections (reacting only after drift had occurred).
* In October 1994, began treating sigma0_uncorr trends as linear in time, making corrections on 0.05 dB quantization. Used the current time trends to predict Cal Table values for 10 or so cycles into the future, at each MCR change. We described in Callahan *et al.* [1994] the linear trend back to cycle 001, for recorrecting the GDR estimates.
* In September 1995, continued treating sigma0_uncorr trends as linear in time, but began making Cal Table changes on 0.03 dB quantization.
* By May 1996, it became clear that the downward drift in sigma0_uncorr departed from being purely linear with time, with downward slope greater for later cycles. Used step-change in Cal Table values and a new linear trend, still changing at 0.03 dB quantization. In September 1996 put in another jump and slope change.
* In October 1996, for both Ku- and C-band, fit the sigma0_uncorr trend by set of line segments continuous in value but discontinuous in slope, with slope changes made on time scale no shorter than ½ year. This new set of table values (in MCR 618) was used for the sigma0 values on the MGDR-B for cycles 001-132.
* In December 1996, the C-band sigma0_uncorr data seemed to be departing from the trend already in the Cal Table and the C-band Cal Table was frozen at one constant value for the next data cycles.
* In August 1997 the Ku- and C-band Cal Table values were projected on new linear trends quantized at 0.03 dB steps. The Ku-band slope was the same as before, but the C-band slope was new.
* In January 1998 there was a three-cycle hold or "freeze" starting at cycle 195, and then the linear trends of August 1997 were continued.
* In May 1998, used quadratic trend fit to project correction values for another dozen cycles, for cycles 210 through 221.

* In January 1999, another quadratic trend projected correction values for cycles 228 through 235. Distracted by the apparent change in Side A point target response (PTR) and its consequences for SWH estimation, we failed to keep up with the correction table values after the May 1998 change; the result was that the processing "ran off the end" of the May 1998 table so that cycles 222 through 227 had constant Cal Table values

Table 2a, columns 5 and 6, lists the Ku- and C-band Cal Table values used in JPL's ground data processing to produce the distributed TOPEX GDRs for cycles 001 through 235; cycles 133-149 in this table are for the reprocessed and re-released GDRs (see HH97 for the originally-distributed values for cycles 133-149). Table 2a is also applicable to the MGDR-Bs for cycles 133 and greater. Table 2b, columns 5 and 6, lists the Ku- and C-band Cal Table values used in the MGDR-B for cycles 001 - 132. Note that Tables 2a and 2b use NRA (for NASA radar altimeter) to designate what we have been calling the TOPEX altimeter in this report. The SSALT in those tables is the French CNES solid-state altimeter which also flew on the TOPEX/Poseidon mission.

TREND FITTING OF SIGMA0 TO ESTIMATE Cal Table VALUES

During the first four years of TOPEX/Poseidon, we had done a variety of least-squares fitting of global over-ocean sigma0_uncorr cycle averages to a fit function whose parameters included 1) the amplitude and phase of both an annual and a semiannual sinusoid; 2) terms linear and quadratic in the Ku-band SWH; and 3) terms linear and quadratic in cycle number (equivalently, in time). In all sigma0_uncorr trend-fitting we use data only from cycles 011 and higher. By assuming that the long-term true sigma0 should be constant, the Cal Table values were taken as equal to the shifted negative values of the trend linear time term. These values were shifted to produce zero correction at cycle 011.

For the entire TOPEX altimeter Side A trend analysis we are using data from cycles 017 through 235. Cycles lower than 017 were mixed TOPEX/SSALT cycles. At the time of HH97 it seemed reasonable for the fit to include the terms in Ku-band SWH but since that time we have seen apparent Side A PTR changes and resulting errors in SWH. Cycles 017 through 235 represent almost six years of data, and the time trend should be adequately fitted without including a SWH dependent term in the fit. The current whole-mission sigma0_uncorr can be represented adequately by a quadratic polynomial for the time terms. We have tried higher order polynomials, but find virtually no improvement in the fit residuals compared to those for the quadratic fit. The Ku-band trend fit results are shown Figure 2a and the C-band trend fit results are shown in Figure 2b. The negative shifted time trend fit values (from the quadratic polynomial in cycle number) are also listed in columns 7 and 8 of Tables 2a and 2b, for Ku- and C-band respectively; and these are our current best estimate of what the Cal Table values should have been for each TOPEX altimeter data cycle.

Figure 3a shows the Ku-band sigma0_uncorr and the fitted time trend from Figure 2a, and also show the shifted inverted Ku-band Cal Table values used in the MGDR-B product. Figures 3a provides a quick visual summary of the effectiveness of the various Cal Table adjustments summarized in Table 1. Figure 3b presents a similar summary for the C-band adjustments. In general our "on the fly"

adjustments of Table 1 were not too bad, but there are problem areas such as cycles 045-070 for the C-band in Figure 3b.

Figure 4 shows a comparison of the annual and semiannual sinusoid fit terms from the fits of Figures 2a and 2b. It is gratifying that the annual terms have approximately the same phase and have similar magnitudes, saying that there are real seasonal effects in the TOPEX sigam0 data. That is not too important for the purpose of this memo, however, because the quadratic time trend fits would have been about the same if there had been no annual and semiannual terms included.

To use these Side A time trend estimates to revise the TOPEX Ku-band GDR sigma0 values for GDRs already distributed, the data user should subtract the Table 2 column 5 value from his GDR sigma0 and then add the Table 2 column 7 value. In other words, the additive adjustment to the GDR Ku-band sigma0 is

Ku adjust = (Ku quadratic fit, Table 2 column 7)
minus
(Ku Cal Table, Table 2, column 5),

and this Ku sigma0 adjustment is plotted in Figure 5a. Similarly the TOPEX C-band additive adjustment is

C adjust = (C quadratic fit, Table 2 column 8)
minus
(C Cal Table, Table 2, column 6),

and this C-band sigma0 adjustment is plotted in Figure 5b. We referred here simply to Table 2, but the user has to decide whether to use Table 2a or Table 2b; Table 2a is appropriate to the TOPEX GDRS for all cycles (with cycles 133-149 having been reprocessed and rereleased) and to the MGDR-Bs for cycle 133 and greater, while Table 2b should be used for MGDR-Bs for cycle 132 and less.

The fitted Ku-band quadratic time trend (Table 2 column 7) is given by

Ku_time_trend = -0.03814 + Ncyc*(3.09049E-03 + Ncyc*3.42692E-05),

where Ncyc is the cycle number. Likewise, the fitted C-band time trend (Table 2, column 8) is

C_time_trend = -0.02661 + Ncyc*(2.06055E-03 + Ncyc*3.26012E-05).

CONCLUSION AND SUMMARY

We have described (and listed in columns 5 and 6 of Table 2) the Cal Table values that were used in producing the distributed TOPEX GDRs and the MGDR-Bs, and then described the time trend fitting of sigma0_uncorr to produce our polynomial fit results for the values which should have been in the Cal Table. These revised values are a quadratic function of time (equivalently, of cycle number), and we provide these revised Cal Table values in columns 7 and 8 of Table 2a and Table 2b. We also provided the algebraic expression for the revised Cal Table values as a function of cycle number. We have taken TOPEX cycle 11 as the zero reference, and our correction procedures compensate for the power measurement's longer-term drifts relative to cycle 11. We have described

how to adjust the sigma0 values on already-distributed GDRs to our polynomial fitted values, and have plotted the Ku- and C-band additive sigma0 adjustments in Figure 5a and 5b.

REFERENCES

Callahan, P.S., D.W. Hancock, III, and G.S. Hayne, "New Sigma0 Calibration for the TOPEX Altimeter," TOPEX/POSEIDON Research News, pp.28-32, Issue 3, October 1994, JPL 410-42, Jet Propulsion Laboratory, Pasadena, CA

Hayne, G.S. and D.W. Hancock III, "TOPEX Sigma0 Calibration Table and its Updates", March 14 1997, NASA Goddard Space Flight Center, Observational Science Branch, Wallops Island, VA (available as PDF document at *http://topex.wff.nasa.gov/docs/Sigma0Cal_HH97.pdf*)

Table 1. TOPEX MCR Information Summary

(from MCR Form)				*(from File Release Form)*				
(1) **MCR #**	(2) **MCR Origination Date**	(3) **Desired Operational Date**	(4) **Comments on MCR Form**	(5) **File Creation Date**	(6) **Release Approval Date**	(7) **File Execution to Begin *(cycle begin)***	(8) **Comments on MCR actions and reasons**	(9) **Cycles Under This MCR**
432	93/05/11 1993-131	93/05/12		93/05/12 1993-132 ?	start of mission		At start of mission, had zeros in both Ku and C AGC table	001 - 047
492	94/01/10 1994-010	cycle 048 94/01/12	Reprocess cycle 48 IGDRs, process all from 48 on using this file	94/01/10 1994-010 T18:05:00	94/01/12	94/01/02 1994-002 T04:28:00 *(cycle 048)*	First non-zero entries. Start applying to IGDRs at cycle 048, and add steps backward at cycles 015, 021, and 029.	048 - 055
501	94/03/30 1994-089	cycle 056 94/03/31	Change to start at cycle 56 IGDRs	94/03/30 1994-089 T23:00:00	94/03/31	94/03/22 1994-081 T12:17:00 *(cycle 056)*	Add another step starting at cycle 056, keep rest of values same as MCR 492.	056 - 075
529	94/10/18 1994-291	cycle 076 94/10/19	Use for cycle 76 IGDRs	94/10/17 1994-290 T14:00:00	94/10/19	94/10/06 1994-279 T19:47:00 *(cycle 076)*	Start at cycle 076, and replace earlier cycle values by linear ramp at 0.05 dB steps.	076 - 081
539	95/01/05 1995-005	95/01/04	Reprocess cycle 80-83, use for 84 onward	95/01/04 1995-004 T19:40:00	95/01/04	94/12/05 1994-339 T07:38:00 *(cycle 082)*	Start at cycle 082. Extend linear ramp of MCR 529, predicting next cycles correction.	082 - 092
548	95/03/24 1995-083	cycle 93 95/03/29	Use for cycle 93 IGDRs	95/03/29 1995-088 T21:20:00	95/03/29	95/01/13 1995-013 T23:32:43 *(cycle 086)*	Start at 093. Use linear prediction for next cycles, earlier values same as MCR 539. Note that begin exec. date is earlier than file creation, for reprocessing.	093 - 102
562	95/07/10 1995-191	95/07/12	Use for cycle 103	95/07/10 1995-191 T20:52:00	95/07/11	95/07/01 1995-182 T13:07:39 *(cycle 103)*	Start at cycle 103 (a SSALT cycle). Extend linear ramp of MCR 548, predicting next cycles correction.	103 - 109
530	95/09/13 1995-256	95/09/15	Use for cycle 110	95/09/14 1995-257 T18:10:00	95/09/15	95/09/08 1995-251 T22:57:19 *(cycle 110)*	Start at cycle 110. Refitted linear trend, extend backward, now using 0.03 dB steps.	110 - 121
585	95/12/13 1995-347	cycle 122 96/01/03	Use for cycle 122	96/01/04 1996-004 T23:21:45	96/01/04	96/01/05 1996-005 T22:39:35 *(cycle 122)*	Start at cycle 122. Linear trend from MCR 530 was extended forward.	122 - 132
618	96/10/01 1996-275	96/10/02	Use as part of reprocessing from cycle 133	96/10/07 1996-281 T17:31:00	96/10/07	96/09/19 1996-263 T18:01:15 *(cycle 148)*	Cycle 150 was SSALT. Execution date earlier than creation date for reprocessed 133-153. Values same as MCR 614 for cycles 001-086, then different (line segment fit). (MCR 618 values used in MGDR-B for cycles 001-153)	133 - 153
629	96/12/04 1996-339	cycle 156 96/12/11	Change before processing cycle 156	96/12/09 1996-344 T22:44:00	96/12/11	96/11/18 1996-323 T05:52:26 *(cycle 154)*	Keep Ku values of MCR 618, but freeze C-band value starting at cycle 154.	154 - 159

Table 1. TOPEX MCR Information Summary

(from MCR Form)				*(from File Release Form)*				
(1) **MCR #**	(2) **MCR Origination Date**	(3) **Desired Operational Date**	(4) **Comments on MCR Form**	(5) **File Creation Date**	(6) **Release Approval Date**	(7) **File Execution to Begin *(cycle begin)***	(8) **Comments on MCR actions and reasons**	(9) **Cycles Under This MCR**
630	97/01/20 1997-020	97/01/22	Use for cycle 160	97/01/22 1997-022 T16:44:00	97/01/22	97/01/16 1997-016 T17:43:34 *(cycle 160)*	Use new line segment fit, start with cycle 160. Values same as MCR 629 until cycle 156.	160 - 164
632	97/03/13 1997-072	97/03/17	Freeze C-band value at cycle 164 value; reprocess 165.	97/03/14 1997-073 T21:44:00	97/03/17	97/02/25 1997-056 T09:37:41 *(cycle 164)*	Freeze C-band value at cycle 164 value, otherwise same values as MCR 630.	165 - 173
638	97/06/09 1997-160	97/06/14	Update before processing cycle 175	97/06/16 1997-167 T17:25:55	97/06/18	97/06/14 1997-165 T11:21:23 *(cycle 175)*	Cycle 174 was SSALT. Continue Ku-band trend, continue to freeze C-band value; earlier cycles same as MCR 632	175 - 179
643	97/08/13 225	97/08/12	Update before processing cycle 181	97/08/18 1997-230 T16:00:00	97/08/18	97/08/12 1997-224 T23:12:33 *(cycle 181)*	Cycle 180 was SSALT. Use new trend fits for Ku- and C-band, starting with cycle 181; earlier cycles same as MCR 638.	181 - 196
654	98/01/23 1998-023	98/01/28	Update before processing cycle 198	98/01/28 1998-028 T22:40:00	98/01/28	98/01/28 1998-028 12:47:30 *(cycle 198)*	Cycle 197 was SSALT. Put in 3-cycle freeze starting at cycle 195, then continue same trends as MCR 643; earlier cycles same as MCR 643.	198 -
666	99/05/28 1998-148	99/05/27	Begin use for cycle 210	98-05/29 1998-149 T21:30:00	99/06/02	98/05/27 1998-147 12:29:53 *(cycle 210)*	Adds another 12 cycles using quadratic trend projections.	210 - 221
684	99/01/07 1999-007	99/01/11	Begin use for cycle 228	99-011 1999-007 T16:06:30	99/01/11	98/10/03 1998-276 10:10:42 *(cycle 223)*	Previous MCR only had values out to cycle 221; cycles 222-227 had same correction as 221. This MCR includes values backward to 221 in case of reprocessing, but cycle 228 was the first to be processed under MCR 684.	228 - 235

Table 2a. TOPEX Cal Table Entries for GDRs (Reprocessed and Rereleased Cycles 133-149); Also Applies to MGDR-Bs for Cycle 133 and Greater

(1) Data Cycle	(2) Cycle Start Year-Day	(3) Altimeter	(4) MCR #	(5) Ku Cal Table Entry, dB	(6) C Cal Table Entry, dB	(7) Poly. Fit Ku Value, dB	(8) Poly. Fit C Value, dB
001	1992-267	mixed	432	0.00	0.00	-0.035	-0.025
002	1992-277	mixed	432	0.00	0.00	-0.032	-0.022
003	1992-286	mixed	432	0.00	0.00	-0.029	-0.020
004	1992-296	mixed	432	0.00	0.00	-0.025	-0.018
005	1992-306	mixed	432	0.00	0.00	-0.022	-0.015
006	1992-316	mixed	432	0.00	0.00	-0.018	-0.013
007	1992-326	mixed	432	0.00	0.00	-0.015	-0.011
008	1992-336	mixed	432	0.00	0.00	-0.011	-0.008
009	1992-346	mixed	432	0.00	0.00	-0.008	-0.005
010	1992-356	mixed	432	0.00	0.00	-0.004	-0.003
011	1992-366	mixed	432	0.00	0.00	+0.000	+0.000
012	1993-010	mixed	432	0.00	0.00	+0.004	+0.003
013	1993-020	mixed	432	0.00	0.00	+0.008	+0.006
014	1993-030	mixed	432	0.00	0.00	+0.012	+0.009
015	1993-039	mixed	432	0.00	0.00	+0.016	+0.012
016	1993-049	mixed	432	0.00	0.00	+0.020	+0.015
017	1993-059	NRA	432	0.00	0.00	+0.024	+0.018
018	1993-069	NRA	432	0.00	0.00	+0.029	+0.021
019	1993-079	NRA	432	0.00	0.00	+0.033	+0.024
020	1993-089	SSALT					
021	1993-099	NRA	432	0.00	0.00	+0.042	+0.031
022	1993-109	NRA	432	0.00	0.00	+0.046	+0.035
023	1993-119	NRA	432	0.00	0.00	+0.051	+0.038
024	1993-129	NRA	432	0.00	0.00	+0.056	+0.042
025	1993-139	NRA	432	0.00	0.00	+0.061	+0.045
026	1993-149	NRA	432	0.00	0.00	+0.065	+0.049
027	1993-158	NRA	432	0.00	0.00	+0.070	+0.053
028	1993-168	NRA	432	0.00	0.00	+0.075	+0.057
029	1993-178	NRA	432	0.00	0.00	+0.080	+0.061
030	1993-188	NRA	432	0.00	0.00	+0.085	+0.065
031	1993-198	SSALT					
032	1993-208	NRA	432	0.00	0.00	+0.096	+0.073
033	1993-218	NRA	432	0.00	0.00	+0.101	+0.077
034	1993-228	NRA	432	0.00	0.00	+0.107	+0.081
035	1993-238	NRA	432	0.00	0.00	+0.112	+0.085
036	1993-248	NRA	432	0.00	0.00	+0.118	+0.090
037	1993-258	NRA	432	0.00	0.00	+0.123	+0.094
038	1993-268	NRA	432	0.00	0.00	+0.129	+0.099
039	1993-277	NRA	432	0.00	0.00	+0.135	+0.103
040	1993-287	NRA	432	0.00	0.00	+0.140	+0.108
041	1993-297	SSALT					
042	1993-307	NRA	432	0.00	0.00	+0.152	+0.117
043	1993-317	NRA	432	0.00	0.00	+0.158	+0.122
044	1993-327	NRA	432	0.00	0.00	+0.164	+0.127
045	1993-337	NRA	432	0.00	0.00	+0.170	+0.132

Table 2a. TOPEX Cal Table Entries for GDRs (Reprocessed and Rereleased Cycles 133-149); Also Applies to MGDR-Bs for Cycle 133 and Greater (continued)

(1) Data Cycle	(2) Cycle Start Year-Day	(3) Altimeter	(4) MCR #	(5) Ku Cal Table Entry, dB	(6) C Cal Table Entry, dB	(7) Poly. Fit Ku Value, dB	(8) Poly. Fit C Value, dB
046	1993-347	NRA	432	0.00	0.00	+0.177	+0.137
047	1993-357	NRA	432	0.00	0.00	+0.183	+0.142
048	1994-002	NRA	492	0.25	0.10	+0.189	+0.147
049	1994-012	NRA	492	0.25	0.10	+0.196	+0.153
050	1994-022	NRA	492	0.25	0.10	+0.202	+0.158
051	1994-031	NRA	492	0.25	0.10	+0.209	+0.163
052	1994-041	NRA	492	0.25	0.10	+0.215	+0.169
053	1994-051	NRA	492	0.25	0.10	+0.222	+0.174
054	1994-061	NRA	492	0.25	0.10	+0.229	+0.180
055	1994-071	SSALT					
056	1994-081	NRA	501	0.30	0.15	+0.242	+0.191
057	1994-091	NRA	501	0.30	0.15	+0.249	+0.197
058	1994-101	NRA	501	0.30	0.15	+0.256	+0.203
059	1994-111	NRA	501	0.30	0.15	+0.263	+0.208
060	1994-121	NRA	501	0.30	0.15	+0.271	+0.214
061	1994-131	NRA	501	0.30	0.15	+0.278	+0.220
062	1994-141	NRA	501	0.30	0.15	+0.285	+0.226
063	1994-150	NRA	501	0.30	0.15	+0.293	+0.233
064	1994-160	NRA	501	0.30	0.15	+0.300	+0.239
065	1994-170	SSALT					
066	1994-180	NRA	501	0.30	0.15	+0.315	+0.251
067	1994-190	NRA	501	0.30	0.15	+0.323	+0.258
068	1994-200	NRA	501	0.30	0.15	+0.330	+0.264
069	1994-210	NRA	501	0.30	0.15	+0.338	+0.271
070	1994-220	NRA	501	0.30	0.15	+0.346	+0.277
071	1994-230	NRA	501	0.30	0.15	+0.354	+0.284
072	1994-240	NRA	501	0.30	0.15	+0.362	+0.291
073	1994-250	NRA	501	0.30	0.15	+0.370	+0.298
074	1994-259	NRA	501	0.30	0.15	+0.378	+0.304
075	1994-269	NRA	501	0.30	0.15	+0.386	+0.311
076	1994-279	NRA	529	0.45	0.35	+0.395	+0.318
077	1994-289	NRA	529	0.45	0.35	+0.403	+0.325
078	1994-299	NRA	529	0.45	0.35	+0.411	+0.332
079	1994-309	SSALT					
080	1994-319	NRA	529	0.45	0.35	+0.428	+0.347
081	1994-329	NRA	529	0.45	0.35	+0.437	+0.354
082	1994-339	NRA	539	0.50	0.40	+0.446	+0.362
083	1994-349	NRA	539	0.50	0.40	+0.454	+0.369
084	1994-359	NRA	539	0.50	0.40	+0.463	+0.377
085	1995-004	NRA	539	0.50	0.40	+0.472	+0.384
086	1995-013	NRA	539	0.55	0.45	+0.481	+0.392
087	1995-023	NRA	539	0.55	0.45	+0.490	+0.399
088	1995-033	NRA	539	0.55	0.45	+0.499	+0.407
089	1995-043	NRA	539	0.55	0.45	+0.508	+0.415
090	1995-053	NRA	539	0.55	0.45	+0.518	+0.423
091	1995-063	SSALT					

Table 2a. TOPEX Cal Table Entries for GDRs (Reprocessed and Rereleased Cycles 133-149); Also Applies to MGDR-Bs for Cycle 133 and Greater (continued)

(1) Data Cycle	(2) Cycle Start Year-Day	(3) Altimeter	(4) MCR #	(5) Ku Cal Table Entry, dB	(6) C Cal Table Entry, dB	(7) Poly. Fit Ku Value, dB	(8) Poly. Fit C Value, dB
092	1995-073	NRA	539	0.55	0.45	+0.536	+0.439
093	1995-083	NRA	548	0.55	0.45	+0.546	+0.447
094	1995-093	NRA	548	0.55	0.45	+0.555	+0.455
095	1995-103	NRA	548	0.55	0.45	+0.565	+0.463
096	1995-113	NRA	548	0.55	0.45	+0.574	+0.472
097	1995-123	SSALT					
098	1995-132	NRA	548	0.55	0.45	+0.594	+0.488
099	1995-142	NRA	548	0.60	0.45	+0.604	+0.497
100	1995-152	NRA	548	0.60	0.45	+0.614	+0.505
101	1995-162	NRA	548	0.60	0.45	+0.624	+0.514
102	1995-172	NRA	548	0.60	0.45	+0.634	+0.523
103	1995-182	SSALT					
104	1995-192	NRA	562	0.65	0.50	+0.654	+0.540
105	1995-202	NRA	562	0.65	0.50	+0.664	+0.549
106	1995-212	NRA	562	0.65	0.50	+0.674	+0.558
107	1995-222	NRA	562	0.70	0.55	+0.685	+0.567
108	1995-232	NRA	562	0.70	0.55	+0.695	+0.576
109	1995-242	NRA	562	0.70	0.55	+0.706	+0.585
110	1995-251	NRA	530	0.75	0.57	+0.716	+0.595
111	1995-261	NRA	530	0.75	0.57	+0.727	+0.604
112	1995-271	NRA	530	0.75	0.60	+0.738	+0.613
113	1995-281	NRA	530	0.75	0.60	+0.749	+0.623
114	1995-291	SSALT					
115	1995-301	NRA	530	0.78	0.60	+0.770	+0.642
116	1995-311	NRA	530	0.78	0.60	+0.781	+0.651
117	1995-321	NRA	530	0.78	0.63	+0.793	+0.661
118	1995-331	NRA	530	0.81	0.63	+0.804	+0.670
119	1995-341	NRA	530	0.81	0.63	+0.815	+0.680
120	1995-351	NRA	530	0.81	0.63	+0.826	+0.690
121	1995-361	NRA	530	0.81	0.63	+0.838	+0.700
122	1996-005	NRA	585	0.84	0.63	+0.849	+0.710
123	1996-015	NRA	585	0.84	0.66	+0.860	+0.720
124	1996-025	NRA	585	0.84	0.66	+0.872	+0.730
125	1996-035	NRA	585	0.84	0.66	+0.884	+0.740
126	1996-045	SSALT					
127	1996-055	NRA	585	0.87	0.66	+0.907	+0.761
128	1996-065	NRA	585	0.87	0.69	+0.919	+0.771
129	1996-075	NRA	585	0.87	0.69	+0.931	+0.782
130	1996-085	NRA	585	0.90	0.69	+0.943	+0.792
131	1996-095	NRA	585	0.90	0.69	+0.955	+0.803
132	1996-105	NRA	585	0.90	0.69	+0.967	+0.813
133	1996-115	NRA	618	1.05	0.81	+0.979	+0.824
134	1996-124	NRA	618	1.05	0.81	+0.991	+0.835
135	1996-134	NRA	618	1.08	0.84	+1.004	+0.846
136	1996-144	NRA	618	1.08	0.84	+1.016	+0.857
137	1996-154	NRA	618	1.08	0.84	+1.028	+0.868

Table 2a. TOPEX Cal Table Entries for GDRs (Reprocessed and Rereleased Cycles 133-149); Also Applies to MGDR-Bs for Cycle 133 and Greater (continued)

(1) Data Cycle	(2) Cycle Start Year-Day	(3) Altimeter	(4) MCR #	(5) Ku Cal Table Entry, dB	(6) C Cal Table Entry, dB	(7) Poly. Fit Ku Value, dB	(8) Poly. Fit C Value, dB
138	1996-164	SSALT					
139	1996-174	NRA	618	1.11	0.90	+1.054	+0.890
140	1996-184	NRA	618	1.14	0.93	+1.066	+0.901
141	1996-194	NRA	618	1.14	0.93	+1.079	+0.912
142	1996-204	NRA	618	1.17	0.96	+1.092	+0.923
143	1996-214	NRA	618	1.17	0.99	+1.105	+0.935
144	1996-224	NRA	618	1.20	1.02	+1.117	+0.946
145	1996-234	NRA	618	1.20	1.05	+1.130	+0.958
146	1996-243	NRA	618	1.23	1.05	+1.144	+0.969
147	1996-253	NRA	618	1.23	1.08	+1.157	+0.981
148	1996-263	NRA	618	1.26	1.11	+1.170	+0.992
149	1996-273	NRA	618	1.26	1.14	+1.183	+1.004
150	1996-283	SSALT					
151	1996-293	NRA	618	1.29	1.17	+1.210	+1.028
152	1996-303	NRA	618	1.32	1.20	+1.223	+1.040
153	1996-313	NRA	618	1.32	1.23	+1.237	+1.052
154	1996-323	NRA	629	1.35	1.26	+1.251	+1.064
155	1996-333	NRA	629	1.35	1.26	+1.264	+1.076
156	1996-343	NRA	629	1.38	1.26	+1.278	+1.088
157	1996-352	NRA	629	1.38	1.26	+1.292	+1.100
158	1996-362	NRA	629	1.41	1.26	+1.306	+1.113
159	1997-006	NRA	629	1.41	1.26	+1.320	+1.125
160	1997-016	NRA	630	1.41	1.29	+1.334	+1.138
161	1997-026	NRA	630	1.41	1.29	+1.348	+1.150
162	1997-036	SSALT					
163	1997-046	NRA	630	1.44	1.32	+1.376	+1.175
164	1997-056	NRA	630	1.47	1.35	+1.390	+1.188
165	1997-066	NRA	632	1.47	1.35	+1.405	+1.201
166	1997-076	NRA	632	1.50	1.35	+1.419	+1.214
167	1997-086	NRA	632	1.50	1.35	+1.434	+1.227
168	1997-096	NRA	632	1.53	1.35	+1.448	+1.240
169	1997-105	NRA	632	1.53	1.35	+1.463	+1.253
170	1997-115	NRA	632	1.56	1.35	+1.478	+1.266
171	1997-125	NRA	632	1.56	1.35	+1.492	+1.279
172	1997-135	NRA	632	1.59	1.35	+1.507	+1.292
173	1997-145	NRA	632	1.59	1.35	+1.522	+1.306
174	1997-155	SSALT					
175	1997-165	NRA	638	1.62	1.35	+1.552	+1.332
176	1997-175	NRA	638	1.62	1.35	+1.567	+1.346
177	1997-185	NRA	638	1.65	1.35	+1.582	+1.359
178	1997-195	NRA	638	1.65	1.35	+1.598	+1.373
179	1997-205	NRA	638	1.68	1.38	+1.613	+1.387
180	1997-215	SSALT					
181	1997-224	NRA	643	1.71	1.41	+1.644	+1.414
182	1997-234	NRA	643	1.71	1.41	+1.659	+1.428
183	1997-244	NRA	643	1.74	1.44	+1.675	+1.442

Table 2a. TOPEX Cal Table Entries for GDRs (Reprocessed and Rereleased Cycles 133-149); Also Applies to MGDR-Bs for Cycle 133 and Greater (continued)

(1) Data Cycle	(2) Cycle Start Year-Day	(3) Altimeter	(4) MCR #	(5) Ku Cal Table Entry, dB	(6) C Cal Table Entry, dB	(7) Poly. Fit Ku Value, dB	(8) Poly. Fit C Value, dB
184	1997-254	NRA	643	1.74	1.44	+1.691	+1.456
185	1997-264	NRA	643	1.77	1.47	+1.706	+1.470
186	1997-274	SSALT					
187	1997-284	NRA	643	1.80	1.50	+1.738	+1.499
188	1997-294	NRA	643	1.80	1.50	+1.754	+1.513
189	1997-304	NRA	643	1.83	1.53	+1.770	+1.527
190	1997-314	NRA	643	1.83	1.53	+1.786	+1.542
191	1997-324	NRA	643	1.86	1.56	+1.802	+1.556
192	1997-334	NRA	643	1.86	1.56	+1.819	+1.571
193	1997-343	NRA	643	1.89	1.59	+1.835	+1.585
194	1997-353	NRA	643	1.89	1.59	+1.851	+1.600
195	1997-363	NRA	643	1.89	1.59	+1.868	+1.615
196	1998-008	NRA	643	1.89	1.59	+1.884	+1.630
197	1998-018	SSALT					
198	1998-028	NRA	654	1.92	1.62	+1.917	+1.659
199	1998-038	NRA	654	1.92	1.62	+1.934	+1.674
200	1998-048	NRA	654	1.95	1.65	+1.951	+1.690
201	1998-058	NRA	654	1.95	1.65	+1.968	+1.705
202	1998-068	NRA	654	1.98	1.68	+1.984	+1.720
203	1998-078	NRA	654	1.98	1.68	+2.001	+1.735
204	1998-088	NRA	654	2.01	1.71	+2.018	+1.750
205	1998-097	NRA	654	2.01	1.71	+2.036	+1.766
206	1998-107	NRA	654	2.04	1.74	+2.053	+1.781
207	1998-117	NRA	654	2.04	1.74	+2.070	+1.797
208	1998-127	NRA	654	2.07	1.77	+2.087	+1.812
209	1998-137	SSALT					
210	1998-147	NRA	666	2.10	1.77	+2.122	+1.844
211	1998-157	NRA	666	2.13	1.80	+2.140	+1.860
212	1998-167	NRA	666	2.13	1.83	+2.157	+1.875
213	1998-177	NRA	666	2.16	1.83	+2.175	+1.891
214	1998-187	NRA	666	2.16	1.86	+2.193	+1.907
215	1998-197	NRA	666	2.19	1.86	+2.210	+1.923
216	1998-207	SSALT	666				
217	1998-216	NRA	666	2.22	1.92	+2.246	+1.956
218	1998-226	NRA	666	2.22	1.92	+2.264	+1.972
219	1998-236	NRA	666	2.25	1.95	+2.282	+1.988
220	1998-246	NRA	666	2.28	1.95	+2.300	+2.005
221	1998-256	NRA	666	2.28	1.98	+2.319	+2.021
222	1998-266	NRA	666	2.28	1.98	+2.337	+2.038
223	1998-276	NRA	666	2.28	1.98	+2.355	+2.054
224	1998-286	SSALT	666				
225	1998-296	NRA	666	2.28	1.98	+2.392	+2.087
226	1998-306	NRA	666	2.28	1.98	+2.411	+2.104
227	1998-316	NRA	666	2.28	1.98	+2.429	+2.121
228	1998-326	NRA	684	2.40	2.07	+2.448	+2.138
229	1998-335	NRA	684	2.40	2.10	+2.467	+2.155

Table 2a. TOPEX Cal Table Entries for GDRs (Reprocessed and Rereleased Cycles 133-149); Also Applies to MGDR-Bs for Cycle 133 and Greater (continued)

(1) Data Cycle	(2) Cycle Start Year-Day	(3) Altimeter	(4) MCR #	(5) Ku Cal Table Entry, dB	(6) C Cal Table Entry, dB	(7) Poly. Fit Ku Value, dB	(8) Poly. Fit C Value, dB
230	1998-345	NRA	684	2.43	2.13	+2.486	+2.172
231	1998-355	NRA	684	2.46	2.13	+2.504	+2.189
232	1998-365	NRA	684	2.46	2.16	+2.523	+2.206
233	1999-010	NRA	684	2.49	2.16	+2.542	+2.223
234	1999-020	SSALT	684				
235	1999-030	NRA	684	2.52	2.19	+2.581	+2.258

Table 2b. TOPEX Cal Table Entries for MGDR-Bs up to Cycle 132

(1) Data Cycle	(2) Cycle Start Year-Day	(3) Altimeter	(4) MCR #	(5) Ku Cal Table Entry, dB	(6) C Cal Table Entry, dB	(7) Poly. Fit Ku Value, dB	(8) Poly. Fit C Value, dB
001	1992-267	mixed	618	-0.06	-0.06	-0.035	-0.025
002	1992-277	mixed	618	-0.06	-0.06	-0.032	-0.022
003	1992-286	mixed	618	-0.06	-0.03	-0.029	-0.020
004	1992-296	mixed	618	-0.03	-0.03	-0.025	-0.018
005	1992-306	mixed	618	-0.03	-0.03	-0.022	-0.015
006	1992-316	mixed	618	-0.03	-0.03	-0.018	-0.013
007	1992-326	mixed	618	-0.03	-0.03	-0.015	-0.011
008	1992-336	mixed	618	0.00	0.00	-0.011	-0.008
009	1992-346	mixed	618	0.00	0.00	-0.008	-0.005
010	1992-356	mixed	618	0.00	0.00	-0.004	-0.003
011	1992-366	mixed	618	0.00	0.00	+0.000	+0.000
012	1993-010	mixed	618	0.00	0.00	+0.004	+0.003
013	1993-020	mixed	618	0.03	0.03	+0.008	+0.006
014	1993-030	mixed	618	0.03	0.03	+0.012	+0.009
015	1993-039	mixed	618	0.03	0.03	+0.016	+0.012
016	1993-049	mixed	618	0.03	0.03	+0.020	+0.015
017	1993-059	NRA	618	0.06	0.03	+0.024	+0.018
018	1993-069	NRA	618	0.06	0.06	+0.029	+0.021
019	1993-079	NRA	618	0.06	0.06	+0.033	+0.024
020	1993-089	SSALT					
021	1993-099	NRA	618	0.09	0.06	+0.042	+0.034
022	1993-109	NRA	618	0.09	0.06	+0.046	+0.037
023	1993-119	NRA	618	0.09	0.06	+0.051	+0.041
024	1993-129	NRA	618	0.09	0.09	+0.056	+0.044
025	1993-139	NRA	618	0.12	0.09	+0.061	+0.048
026	1993-149	NRA	618	0.12	0.09	+0.065	+0.052
027	1993-158	NRA	618	0.12	0.09	+0.070	+0.056
028	1993-168	NRA	618	0.12	0.09	+0.075	+0.059
029	1993-178	NRA	618	0.15	0.12	+0.080	+0.063
030	1993-188	NRA	618	0.15	0.12	+0.085	+0.067
031	1993-198	SSALT					
032	1993-208	NRA	618	0.15	0.12	+0.096	+0.075
033	1993-218	NRA	618	0.18	0.12	+0.101	+0.080
034	1993-228	NRA	618	0.18	0.15	+0.107	+0.084
035	1993-238	NRA	618	0.18	0.15	+0.112	+0.088
036	1993-248	NRA	618	0.18	0.15	+0.118	+0.093
037	1993-258	NRA	618	0.21	0.15	+0.123	+0.097
038	1993-268	NRA	618	0.21	0.15	+0.129	+0.102
039	1993-277	NRA	618	0.21	0.18	+0.135	+0.106
040	1993-287	NRA	618	0.21	0.18	+0.140	+0.111
041	1993-297	SSALT					
042	1993-307	NRA	618	0.24	0.18	+0.152	+0.120
043	1993-317	NRA	618	0.24	0.18	+0.158	+0.125
044	1993-327	NRA	618	0.24	0.21	+0.164	+0.130
045	1993-337	NRA	618	0.27	0.21	+0.170	+0.135
046	1993-347	NRA	618	0.27	0.21	+0.177	+0.140
047	1993-357	NRA	618	0.27	0.21	+0.183	+0.145

Table 2b. TOPEX Cal Table Entries for MGDR-Bs up to Cycle 132 (continued)

(1) Data Cycle	(2) Cycle Start Year-Day	(3) Altimeter	(4) MCR #	(5) Ku Cal Table Entry, dB	(6) C Cal Table Entry, dB	(7) Poly. Fit Ku Value, dB	(8) Poly. Fit C Value, dB
048	1994-002	NRA	618	0.27	0.21	+0.189	+0.150
049	1994-012	NRA	618	0.30	0.21	+0.196	+0.155
050	1994-022	NRA	618	0.30	0.24	+0.202	+0.161
051	1994-031	NRA	618	0.30	0.24	+0.209	+0.166
052	1994-041	NRA	618	0.30	0.24	+0.215	+0.171
053	1994-051	NRA	618	0.33	0.24	+0.222	+0.177
054	1994-061	NRA	618	0.33	0.24	+0.229	+0.182
055	1994-071	SSALT					
056	1994-081	NRA	618	0.33	0.27	+0.242	+0.194
057	1994-091	NRA	618	0.36	0.27	+0.249	+0.200
058	1994-101	NRA	618	0.36	0.27	+0.256	+0.205
059	1994-111	NRA	618	0.36	0.27	+0.263	+0.211
060	1994-121	NRA	618	0.36	0.30	+0.271	+0.217
061	1994-131	NRA	618	0.39	0.30	+0.278	+0.223
062	1994-141	NRA	618	0.39	0.30	+0.285	+0.229
063	1994-150	NRA	618	0.39	0.30	+0.293	+0.235
064	1994-160	NRA	618	0.39	0.30	+0.300	+0.242
065	1994-170	SSALT					
066	1994-180	NRA	618	0.42	0.33	+0.315	+0.254
067	1994-190	NRA	618	0.42	0.33	+0.323	+0.261
068	1994-200	NRA	618	0.42	0.33	+0.330	+0.267
069	1994-210	NRA	618	0.45	0.33	+0.338	+0.274
070	1994-220	NRA	618	0.45	0.36	+0.346	+0.280
071	1994-230	NRA	618	0.45	0.36	+0.354	+0.287
072	1994-240	NRA	618	0.45	0.36	+0.362	+0.293
073	1994-250	NRA	618	0.48	0.36	+0.370	+0.300
074	1994-259	NRA	618	0.48	0.36	+0.378	+0.307
075	1994-269	NRA	618	0.48	0.36	+0.386	+0.314
076	1994-279	NRA	618	0.48	0.39	+0.395	+0.321
077	1994-289	NRA	618	0.48	0.39	+0.403	+0.328
078	1994-299	NRA	618	0.51	0.39	+0.411	+0.335
079	1994-309	SSALT					
080	1994-319	NRA	618	0.51	0.39	+0.428	+0.350
081	1994-329	NRA	618	0.51	0.42	+0.437	+0.357
082	1994-339	NRA	618	0.54	0.42	+0.446	+0.364
083	1994-349	NRA	618	0.54	0.42	+0.454	+0.372
084	1994-359	NRA	618	0.54	0.42	+0.463	+0.379
085	1995-004	NRA	618	0.54	0.42	+0.472	+0.387
086	1995-013	NRA	618	0.57	0.45	+0.481	+0.394
087	1995-023	NRA	618	0.57	0.45	+0.490	+0.402
088	1995-033	NRA	618	0.57	0.45	+0.499	+0.410
089	1995-043	NRA	618	0.60	0.45	+0.508	+0.418
090	1995-053	NRA	618	0.60	0.45	+0.518	+0.426
091	1995-063	SSALT					
092	1995-073	NRA	618	0.63	0.48	+0.536	+0.442
093	1995-083	NRA	618	0.63	0.48	+0.546	+0.450
094	1995-093	NRA	618	0.63	0.48	+0.555	+0.458
095	1995-103	NRA	618	0.66	0.48	+0.565	+0.466

Table 2b. TOPEX Cal Table Entries for MGDR-Bs up to Cycle 132 (continued)

(1) Data Cycle	(2) Cycle Start Year-Day	(3) Altimeter	(4) MCR #	(5) Ku Cal Table Entry, dB	(6) C Cal Table Entry, dB	(7) Poly. Fit Ku Value, dB	(8) Poly. Fit C Value, dB
096	1995-113	NRA	618	0.66	0.51	+0.574	+0.474
097	1995-123	SSALT					
098	1995-132	NRA	618	0.69	0.51	+0.594	+0.491
099	1995-142	NRA	618	0.69	0.51	+0.604	+0.500
100	1995-152	NRA	618	0.69	0.51	+0.614	+0.508
101	1995-162	NRA	618	0.72	0.54	+0.624	+0.517
102	1995-172	NRA	618	0.72	0.54	+0.634	+0.525
103	1995-182	SSALT					
104	1995-192	NRA	618	0.75	0.57	+0.654	+0.543
105	1995-202	NRA	618	0.75	0.57	+0.664	+0.552
106	1995-212	NRA	618	0.75	0.57	+0.674	+0.561
107	1995-222	NRA	618	0.78	0.57	+0.685	+0.570
108	1995-232	NRA	618	0.78	0.60	+0.695	+0.579
109	1995-242	NRA	618	0.78	0.60	+0.706	+0.588
110	1995-251	NRA	618	0.81	0.60	+0.716	+0.597
111	1995-261	NRA	618	0.81	0.63	+0.727	+0.607
112	1995-271	NRA	618	0.81	0.63	+0.738	+0.616
113	1995-281	NRA	618	0.84	0.63	+0.749	+0.625
114	1995-291	SSALT					
115	1995-301	NRA	618	0.84	0.66	+0.770	+0.644
116	1995-311	NRA	618	0.87	0.66	+0.781	+0.654
117	1995-321	NRA	618	0.87	0.69	+0.793	+0.663
118	1995-331	NRA	618	0.87	0.69	+0.804	+0.673
119	1995-341	NRA	618	0.90	0.69	+0.815	+0.683
120	1995-351	NRA	618	0.90	0.69	+0.826	+0.693
121	1995-361	NRA	618	0.93	0.72	+0.838	+0.703
122	1996-005	NRA	618	0.93	0.72	+0.849	+0.713
123	1996-015	NRA	618	0.93	0.72	+0.860	+0.723
124	1996-025	NRA	618	0.96	0.75	+0.872	+0.733
125	1996-035	NRA	618	0.96	0.75	+0.884	+0.743
126	1996-045	SSALT					
127	1996-055	NRA	618	0.99	0.75	+0.907	+0.764
128	1996-065	NRA	618	0.99	0.78	+0.919	+0.774
129	1996-075	NRA	618	0.99	0.78	+0.931	+0.784
130	1996-085	NRA	618	1.02	0.78	+0.943	+0.795
131	1996-095	NRA	618	1.02	0.78	+0.955	+0.806
132	1996-105	NRA	618	1.05	0.81	+0.967	+0.816

Figure 1a. Ku Cycle-Average Cal 1 and Cal 2 Delta AGC and Sigma0 (Cal Table Corrections Removed)

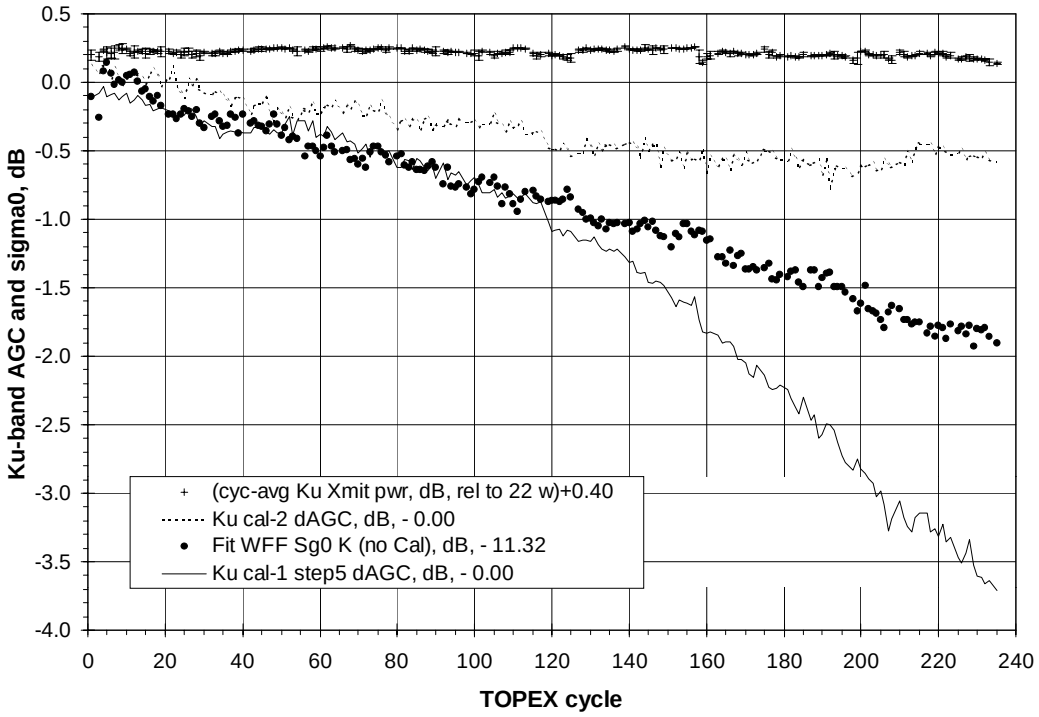

Figure 1b. C-Band Cycle-Average Cal 1 and Cal 2 Delta AGC and Sigma0 (Cal Table Corrections Removed)

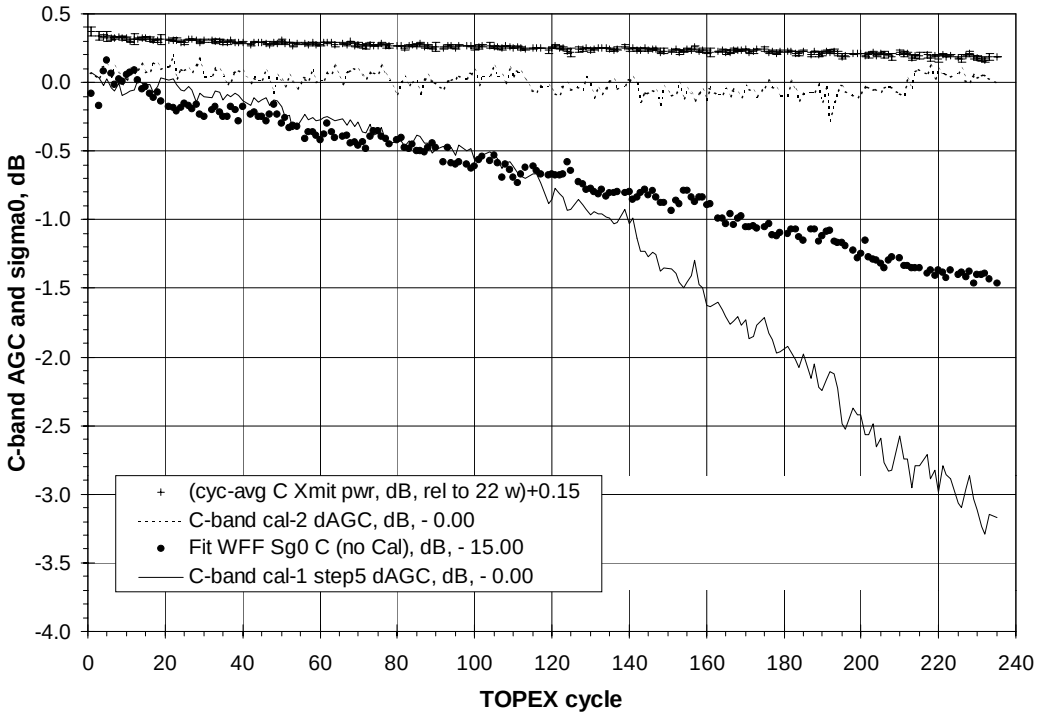

Figure 2a. Side A Ku-Band Sigma0 Cycle-Averages & Cycle 017-235 Fit After Removing Calibration Table Correction

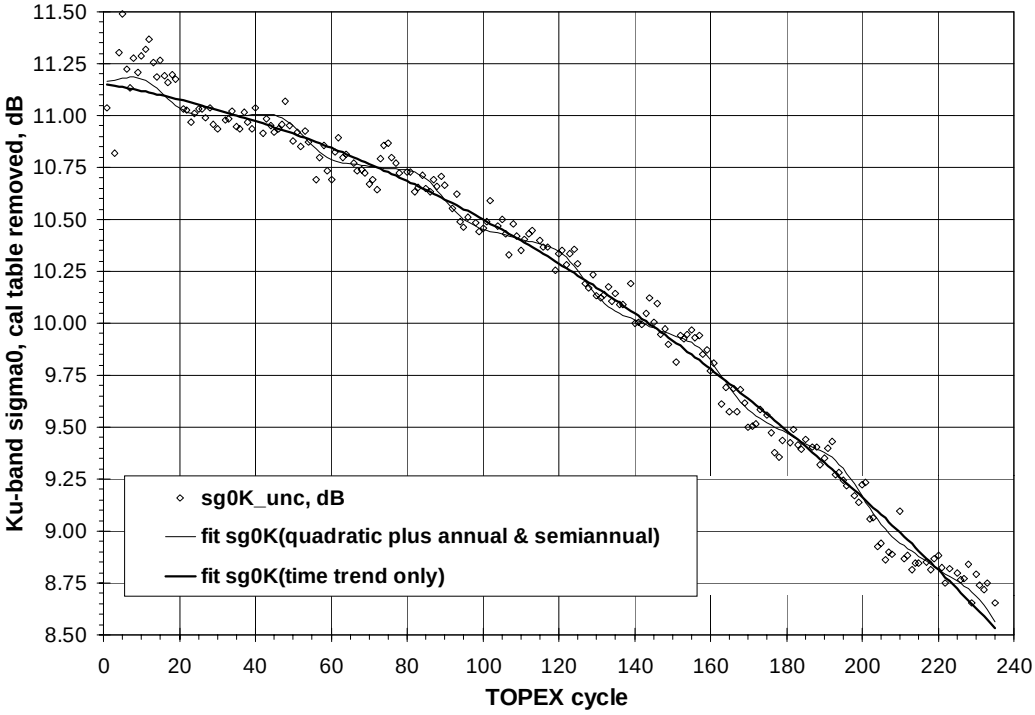

Figure 2b. Side A C-Band Sigma0 Cycle-Averages & Cycle 017-235 Fit After Removing Calibration Table Correction

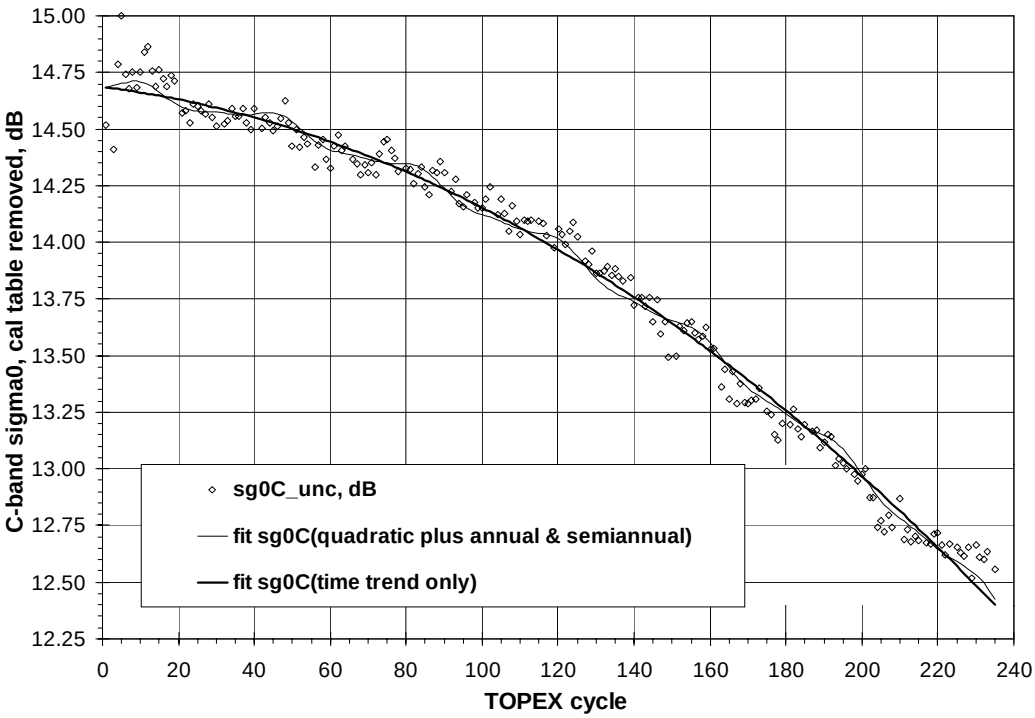

Figure 3a. Ku-Band Sigma0 Cycle-Averages
(Cal Table Corrections Removed)

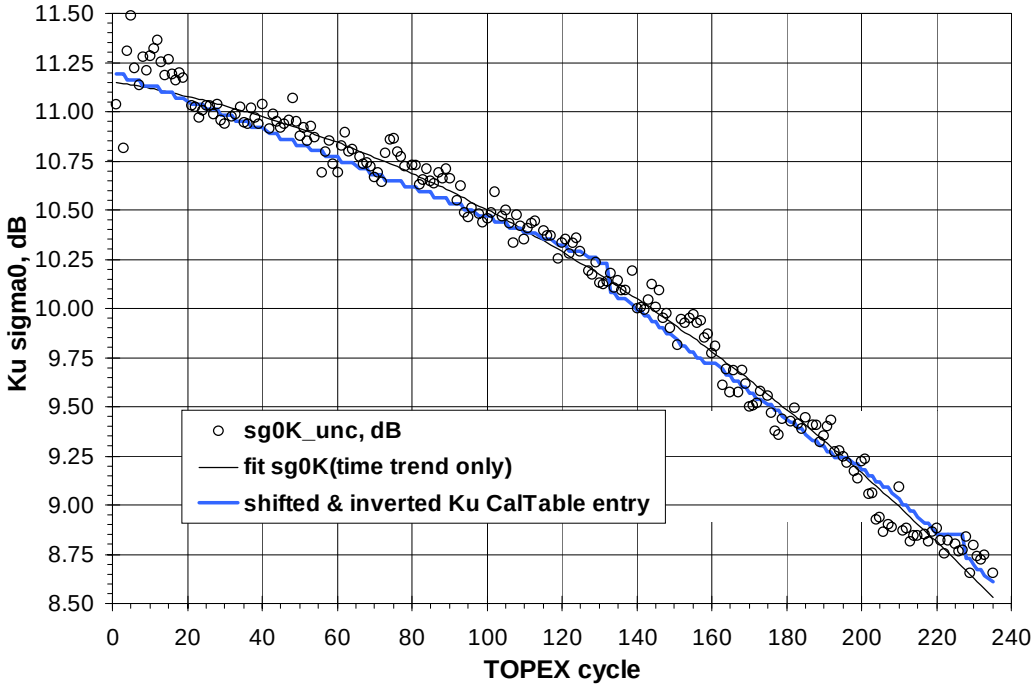

Figure 3b. C-Band Sigma0 Cycle-Averages
(Cal Table Corrections Removed)

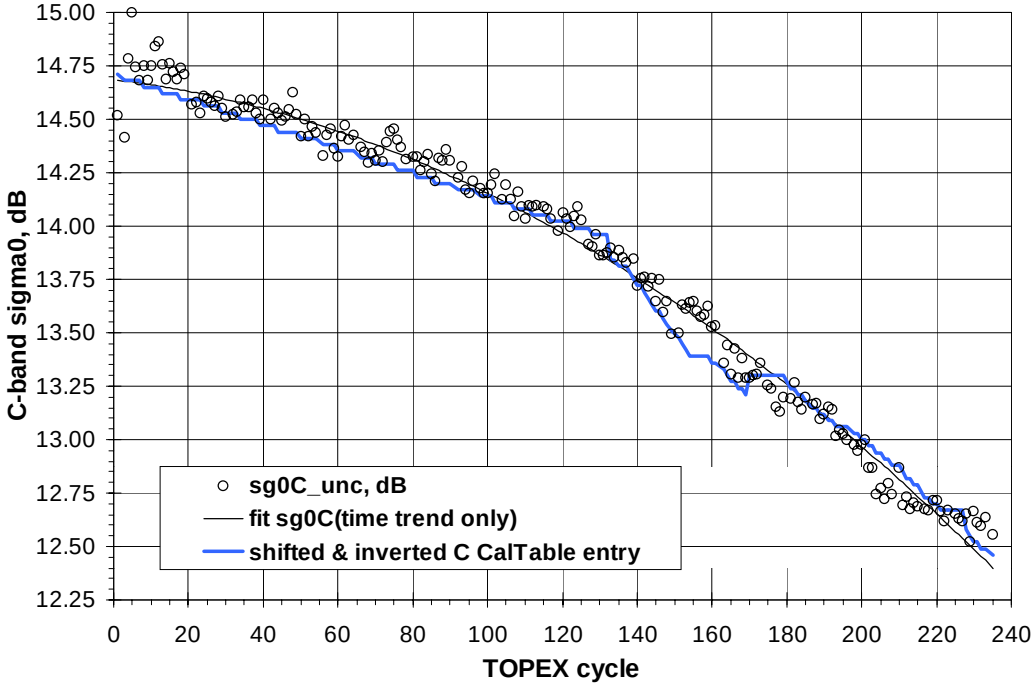

Figure 4. TOPEX Side A Ku-Band & C-Band Annual and Semiannual Terms in Cycle 017-235 Fit to Sigma0 (Cal Table Removed)

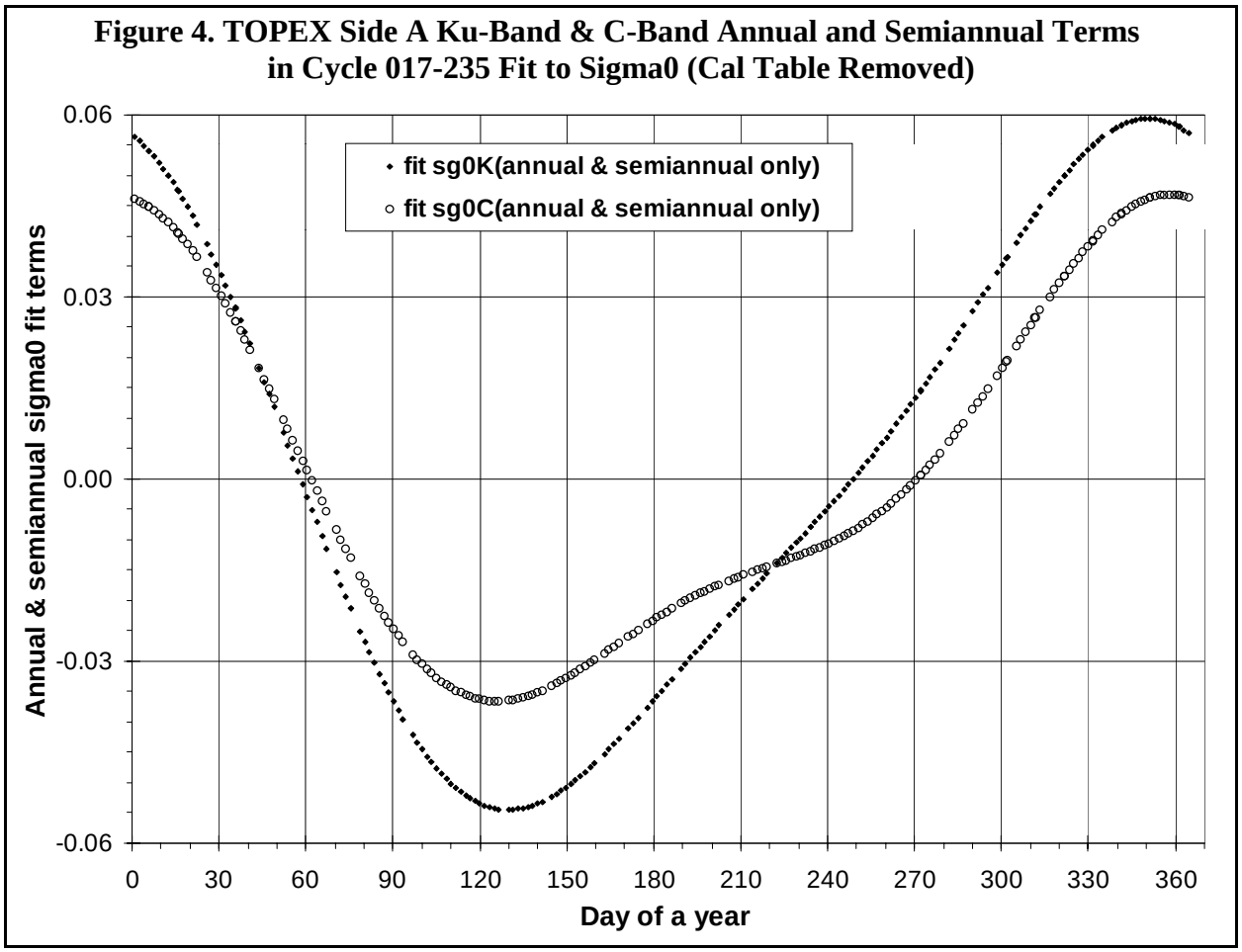

Figure 5a. Ku-Band Additive Adjustments to GDR and MGDR-B Values

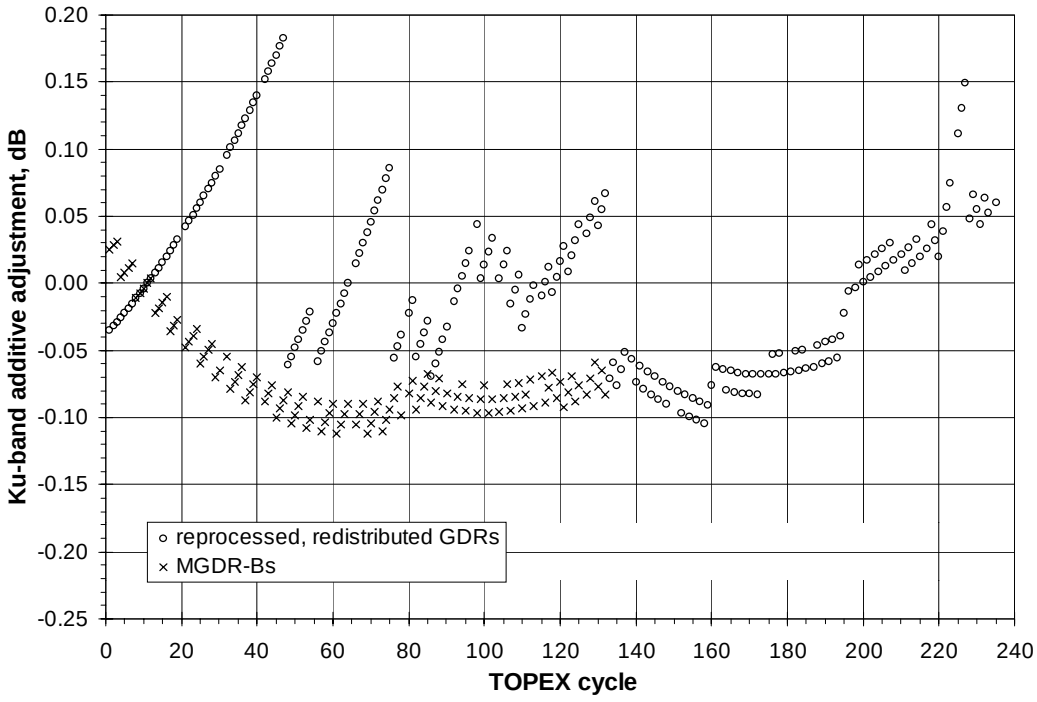

Figure 5b. C-Band Additive Adjustments to GDR and MGDR-B Values